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(54) Title of the Invention: Electronic Still Camera Equipped with Fish-eye Lens

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(72) Inventor: Seiki Kurahashi
c/o Casio K.K., Hanemura Technology Center
3-2-1 Sakae-machi, Hanemura-cho, Nishi-Tama-gun, Tokyo

(71) Applicant: Casio K.K.
2-6-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo

(74) Agent: Takehiko Suzue, Patent Attorney, and two others

SPECIFICATION

1. Title of the Invention

Electronic Still Camera Equipped with Fish-eye Lens

2. Claims

An electronic still camera equipped with a fish-eye lens, characterized by comprising:

a fish-eye lens;

photo-electric conversion means for converting the image data imaged through this fish-eye lens into an electrical signal;

image data storage means for storing the image data converted into an electrical signal by the photo-electric conversion means;

fish-eye distortion storage means for storing distortion information about the image data that has passed through the fish-eye lens;

fish-eye image correction means for correcting the image data stored by the image data storage means on the basis of said distortion information; and

corrected image output means for outputting the image data corrected by this correction means.

3. Detailed Description of the Invention

(Field of Industrial Utilization)

The present invention relates to an electronic still camera equipped with a fish-eye lens.

(Prior Art and Related Problems)

Taking a picture using a fish-eye lens generally allows the subject to be photographed over a wide range, but there is distortion in the image thus obtained corresponding to the curvature of the fish-eye lens. In this case, the distortion in an image captured with the above-mentioned fish-eye lens could not be eliminated with a conventional camera.

Therefore, in the past an image captured using a fish-eye lens could only be reproduced as an image having a distinctive distortion, regardless of whether it is a video or photographic image.

(Object of the Invention)

The present invention was conceived in light of the above problems, and it is an object thereof to provide an electronic still camera equipped with a fish-eye lens, with which a distortion-free image can be reproduced even when a picture is taken with the fish-eye lens.

(Essence of the Invention)

Specifically, the electronic still camera equipped with a fish-eye lens pertaining to the present invention comprises a fish-eye lens, photo-electric conversion means for converting the image data imaged through this fish-eye lens into an electrical signal, image data storage means for storing the image data converted into an electrical signal by the photo-electric conversion means, fish-eye distortion storage means for storing distortion information about the image data that has passed through the fish-eye lens, fish-eye image correction means for correcting the image data stored by the image data storage means on the basis of this distortion information, and corrected image output means for outputting the image data corrected by this correction means.

(Working Examples of the Invention)

A working example of the present invention will now be described through reference to the figures.

Figure 1 illustrates the structure of the electronic circuitry thereof. In this figure, 11 is a controller, and a key input component 12 is connected to this controller 11. This key input component 12 has a region designation key for designating individual partial images in regions (1 through 9) divided up ahead of time from the image region captured through the fish-eye lens, a correction designation key for designating correction of distortion caused by the above-mentioned fish-eye lens, a reproduction command key for reproducing the captured image, and so forth. The controller 11 controls the writing and reading of image data in an image data memory 13 according to instructions from this key input component 12, the reading designation of an image data memory address in a fish-eye image address storage component 14, the reading of distortion factor data in a fish-eye lens distortion factor storage component 15, the correction of fish-eye image data in a fish-eye image correction circuit 16, and the writing and reading of corrected image data in a corrected image memory 17.

18a and 18b are fish-eye lenses, and the optical image data obtained through these fish-eye lenses 18a and 18b goes through stops 19a and 19b and a shutter 20, and is imaged as captured image data by an imager 21. This imager 21 consists of a CCD solid taking element, for example, and converts the imaged optical image into an electrical signal. This image data that has been converted into an electrical signal is sent to an A/D converter 22. This A/D converter 22 converts the image data given by the above-mentioned imager 21 into digital data corresponding to the electrical signal levels for individual pixels, and the digital image data from this A/D converter 22 is written to the image data memory 13. In this case, as shown in Figures 2A and 2B, the circular image data obtained through the fish-eye lenses 18a and 18b is stored just as it is as digital data in the image data memory 13.

The digital image data stored in the above-mentioned image data memory 13 or in the corrected image memory 17 is converted into analog image data in a D/A converter 23 and given to a processing circuit 24. This processing circuit 24 separates the analog image data given by the D/A converter 23 into a brightness signal Y and a color difference signal C "(R – Y) (B – Y)," and the Y/C separated image signal from this processing circuit 24 is outputted and

reproduced by being made into an NTSC (National Television Systems Committee) video signal by an encoder 25.

As shown in Figures 3A to 3I, nine pre-divided regions 1 through 9 are determined in the fish-eye image data stored in the image data memory 13, and the memory addresses corresponding to these nine regions are stored in the fish-eye image address storage component 14. Meanwhile, the fish-eye lens distortion factor storage component 15 stores the fish-eye lens distortion factors corresponding to memory data at the individual addresses of the image data stored in the above-mentioned image data memory 13. In other words, the fish-eye image correction circuit 16 corrects one region (any one from 1 to 9) of the image data stored in the image data memory 13 to undistorted image data on the basis of the fish-eye lens distortion factor corresponding to that memory region.

Next will be described the reproduction of an image captured by an electronic still camera equipped with a fish-eye lens structured as above.

Figure 4 is a flow chart illustrating this image reproduction. Here, the optical image that has passed through the fish-eye lenses 18a and 18b as shown in Figure 2A is stored in the image data memory 13 as shown in Figure 2B via the stops 19a and 19b, the shutter 20, the imager 21, and the A/D converter 22 according to the shutter operation performed by the user.

Specifically, the first step in reproducing the fish-eye image data stored in the above-mentioned image data memory 13 is to operate the reproduction command key of the key input component 12 (step S1). Here, if correction of fish-eye distortion is not to be performed, the correction designation key in the key input component 12 is not operated, so the image data stored in the image data memory 13 is successively read out from the memory data in all the regions thereof at the address control of the controller 11, and is given to the D/A converter 23 (steps S2 and S3). As a result, image data captured in fish-eye perspective (see Figure 2B) is converted into analog data by the D/A converter 23, after which it goes through the processing circuit 24 and the encoder 25, is converted into an NTSC video signal in the same unmodified form as it was captured in fish-eye perspective, and is outputted for display on a television receiver or the like (step S10).

Meanwhile, to perform correction of the fish-eye distortion, after operation of the reproduction command key of the key input component 12, the correction designation key is operated, and one of the image regions 1 through 9 in Figure 3 (number 1 in this case) which have not undergone distortion correction is designated with the region designation key, whereupon the image data corresponding to the designated region is read out from the image data memory 13 indicated by the circled "1" in Figure 5A through reference to the fish-eye image address storage component 14, and this is successively stored in a buffer inside the fish-eye image correction circuit 16 (steps S1, S2 → S4, and S5). Meanwhile, the fish-eye lens distortion factor corresponding to the memory address in the designated region 1 of the above-mentioned image data is read out from the fish-eye lens distortion factor storage component 15 and successively provided to the fish-eye image correction circuit 16 (step S6).

Here, the fish-eye image correction circuit 16 executes correction processing of the fish-eye image data corresponding to the designated region 1 previously read out from the image data memory 13 in step S5 above on the basis of the fish-eye lens distortion factor of the designated region 1 obtained from the fish-eye lens distortion factor storage component 15 (step S7). Then, the image data with no fish-eye distortion after this correction processing is successively stored in the corrected image memory 17 (step S8). As a result, as shown in Figure 5A, the fish-eye image data corresponding to the designated region 1 is corrected to image data with no fish-eye distortion and written to the corrected image memory 17, and then converted into analog data by the D/A converter 23, after which it is outputted as an NTSC video signal via the processing circuit 24 and the encoder 25, and is reproduced for display on a television receiver, for example (step S9 and S10).

Meanwhile, in step S4 above, if region 8 out of the fish-eye image data in Figure 3 is designated by operation of the region designation key of the key input component 12, then the fish-eye image data corresponding to the designated region 8 will be corrected to image data with no fish-eye distortion and written to the corrected image memory 17 via the same processing as in steps S5 to S8 above, as shown in Figure 5B. Thus, the corrected image data corresponding to this region 8 will be outputted and displayed as an NTSC video signal via the D/A converter 23, processing circuit 24, and encoder 25 (steps S9 and S10).

Therefore, with an electronic still camera equipped with a fish-eye lens structured as above, designating any of the regions 1 through 9 out of the image data captured through the fish-eye lenses 18a and 18b allows fish-eye distortion correction to be performed for the image data designated region on the basis of the fish-eye distortion factor corresponding to this designated region, so fish-eye image data captured over a wide range can be reproduced and displayed without any distortion.

(Effect of the Invention)

As discussed above, the present invention comprises photo-electric conversion means for converting image data that has been imaged through a fish-eye lens into an electrical signal, image data storage means for storing the image data converted into an electrical signal by the photo-electric conversion means, fish-eye distortion storage means for storing distortion information about the image data that has passed through the fish-eye lens, fish-eye image correction means for correcting the image data stored by the image data storage means on the basis of this distortion information, and corrected image output means for outputting the image data corrected by this correction means, and therefore the present invention provides an electronic still camera equipped with a fish-eye lens, with which a distortion-free image can be reproduced even when a picture is taken using the fish-eye lens.

4. Brief Description of the Drawings

Figure 1 is a block diagram illustrating the structure of an electronic still camera equipped with a fish-eye lens pertaining to a working example of the present invention;

Figures 2A and 2B are diagrams of the image captured with a fish-eye lens in the above-mentioned electronic still camera and the state in which this image is stored, respectively;

Figures 3A to 3I are diagrams of the segmented correction regions of the fish-eye image data;

Figure 4 is a flow chart of image reproduction with the above-mentioned electronic still camera; and

Figures 5A and 5B are diagrams of the state of fish-eye image correction corresponding to designated regions 1 and 8, respectively, with the above-mentioned electronic still camera.

11 ... controller, 12 ... key input component, 13 ... image data memory, 14 ... fish-eye image address storage component, 15 ... fish-eye lens distortion factor storage component, 16 ... fish-eye image correction circuit, 17 ... corrected image memory, 18a and 18b ... fish-eye lenses, 19a and 19b ... stops, 20 ... shutter, 21 ... imager, 22 ... A/D converter, 23 ... D/A converter, 24 ... processing circuit, 25 ... encoder

Applicant Agent: Takehiko Suzue, Patent Attorney

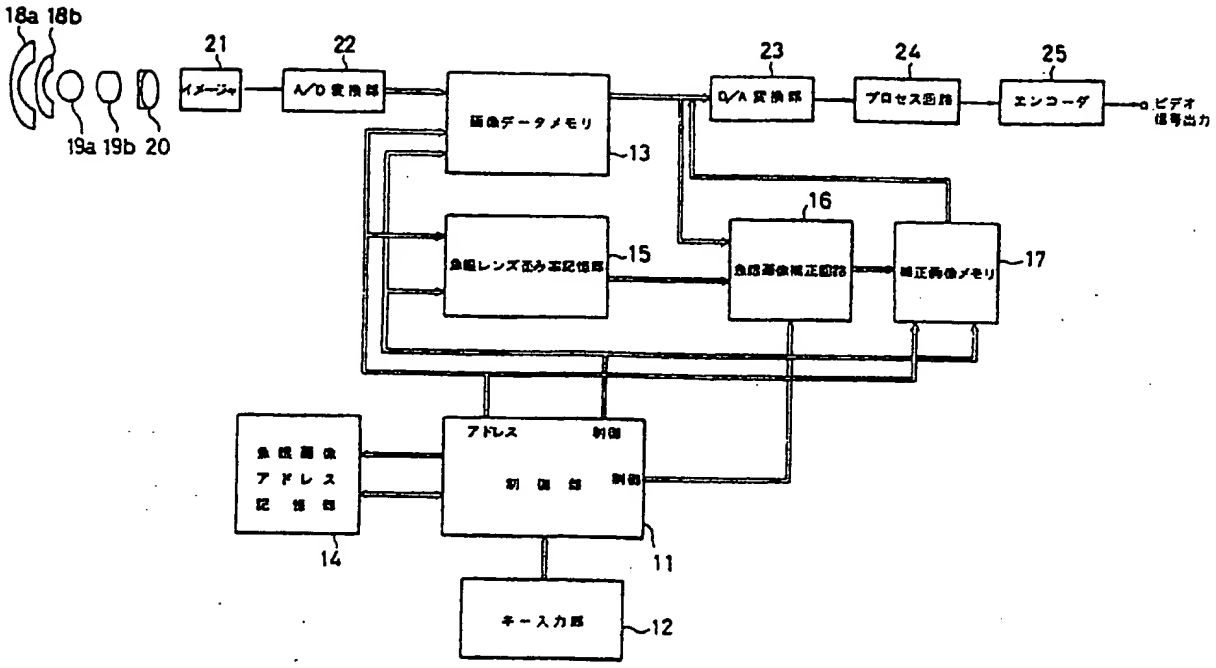

Figure 1

11. controller, 12. key input component, 13. image data memory, 14. fish-eye image address storage component, 15. fish-eye lens distortion factor storage component,
16. fish-eye image correction circuit, 17. corrected image memory, 21. imager,
22. A/D converter, 23. D/A converter, 24. processing circuit, 25. encoder,
a. video (signal output), b. address, c. control

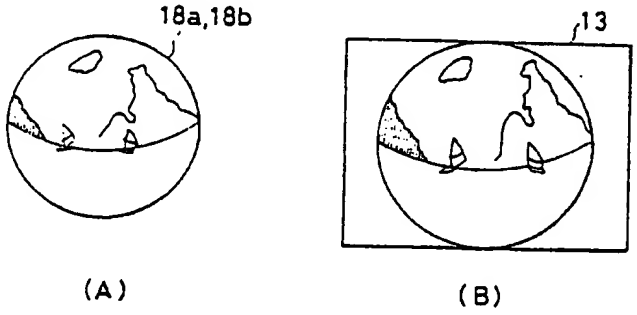

Figure 2

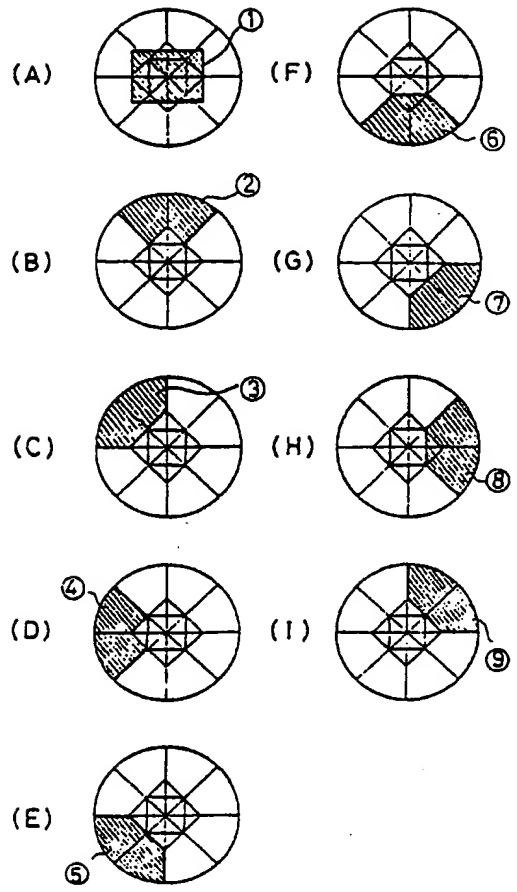

Figure 3

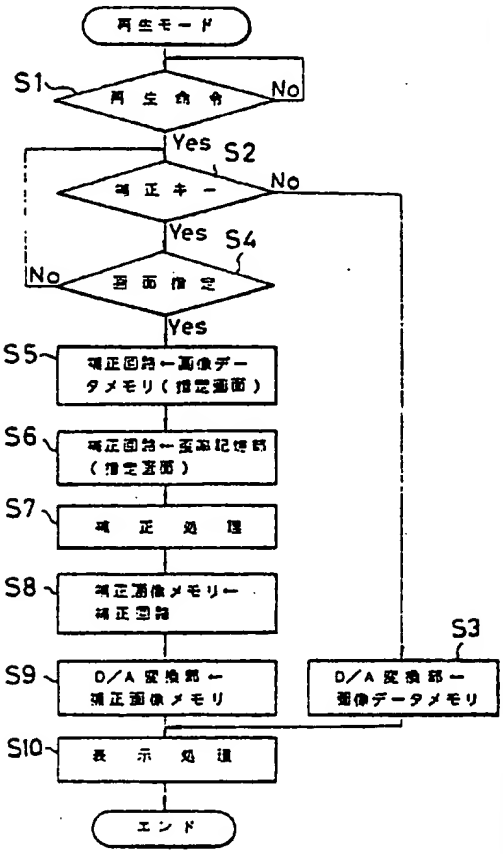

Figure 4

a. Reproduction mode
S1. Reproduction command
S2. Correction key
S3. D/A converter ← image data memory
S4. Image designation
S5. Correction circuit ← image data memory (designated image)
S6. Correction circuit ← distortion factor storage component (designated image)
S7. Correction processing
S8. Corrected image memory ← correction circuit
S9. D/A converter ← corrected image memory
S10. Display processing
b. End

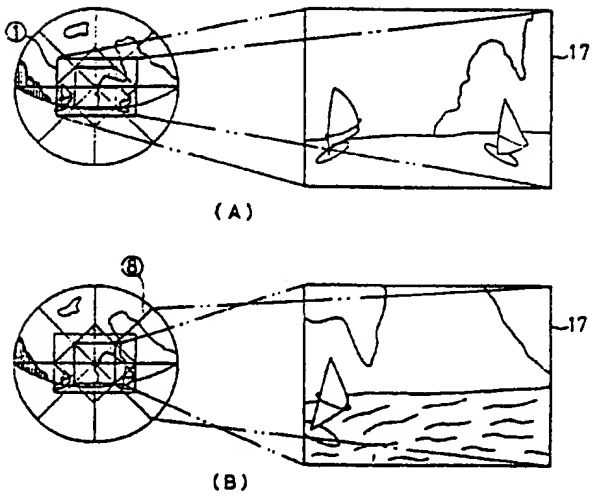

Figure 5